CELLULAR AND MOLECULAR BIOLOGY FORMATIVE QUESTIONS EXAM I

September 13, 1999

For the following questions, select the one BEST ANSWER or COMPLETION.

Dr. Manning

1. The substrates for the two enzymatic reactions in the citric acid cycle in which CO_2 is liberated are

   A. citrate and α-ketoglutarate.
   B. isocitrate and α-ketoglutarate.
   C. cis-aconitate and α-ketoglutarate.
   D. citrate and isocitrate.
   E. isocitrate and oxaloacetate.

2. Which conenzyme is **NOT** required in the pyruvate dehydrogenase and α-ketoglutarate dehydrogenase reactions?

   A. Biotin
   B. Lipoic acid
   C. Thiamine pyrophosphate
   D. FAD
   E. NAD^+

3. The conversion of succinate to fumarate in the citric acid cycle resembles that of acyl-CoA to enoyl-CoA in fatty acid oxidation because both reactions involve

   A. decarboxylation.
   B. oxidation by NAD^+.
   C. phosphorylation.
   D. oxidation by FAD.
   E. transamination.

4. Cytochromes are

   A. riboflavin-containing dehydrogenase proteins.
   B. pyridine nucleotide dehydrogenase proteins.
   C. iron-porphyrin proteins.
   D. metal containing flavoproteins.
   E. non-heme iron proteins.

5. Cyanide is poisonous because of its property of

A. formation of a complex with hemoglobin.
B. combination with the erythrocyte membrane.
C. inhibition of cytochrome oxidase.
D. inhibition of myoglobin.
E. blockage of oxygen transport in the blood.

6. For a redox reaction, the standard reduction potentials ($E^{o'}$) of the two redox pairs make it possible to calculate

A. the reaction rate.
B. the standard free energy change ($\Delta G^{o'}$).
C. the activation energy.
D. the pH.
E. none of the above.

7. All of the following are reducing sugars **EXCEPT**

A. glucose.
B. galactose.
C. fructose.
D. sucrose.
E. ribose.

8. What types of linkages are present between the glucose units of glycogen?

A. β-1,4 linkages only
B. β-1,4 and β-1,6 linkages
C. α-1,4 linkages only
D. α-1,4 and α-1,6 linkages
E. β-1,6 linkages only

Dr. Rosenberg

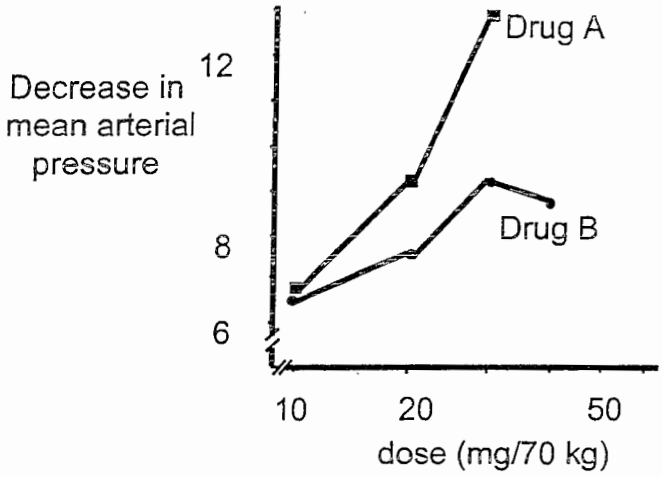
9. The following represents the interaction between a drug and a receptor. The step indicated by the underline represents

$$D + R \rightleftharpoons DR \rightleftharpoons DR \longrightarrow \longrightarrow \longrightarrow \text{effect}$$

A. affinity.
B. efficacy.
C. signal transduction.
D. pharmacodynamics.
E. pharmacokinetics.

For questions 10 through 11, use the following graph to answer.

These data are derived from a clinical trial comparing two drugs to treat hypertension. It is known that both drugs cause the effect by acting at the same receptors.



10. Which statement best describes the results?

A. These are 2 agonists
B. A is an agonist; B is an antagonist
C. A is an agonist; B is a partial antagonist
D. B is an agonist; A is a partial agonist
E. B is an agonist; A is an antagonist

11. Choose the correct statement.

A. These are quantal data.
B. These are graded data.
C. Drug B is safer than drug A.
D. Drug A is safer than Drug B.
E. None of the above.

For the following questions, select the one BEST ANSWER or COMPLETION.

Dr. Banerji

12. Arginase catalyzes the formation of what compound from arginine?

A. Argininosuccinate
B. Citrulline
C. Carbamoyl phosphate
D. Fumerate
E. Urea

13. Urea is released from the urea cycle

A. upon cleavage of arginine.
B. in the transamination of oxaloacetate.
C. during the formation of carbamoyl phosphate from NH_4^+ and CO_2.
D. upon cleavage of argino-succinate.
E. upon the deamination of glutamate.

14. Which of the following amino acids is **NOT** ketogenic?

A. Tryptophan
B. Isoleucine
C. Alanine
D. Phenylalanine
E. Tyrosine

15. The following list relates a metabolic disorder of amino acid degradation with its affected enzyme(or co-factor) and parent amino acid. Which is the **INCORRECT** grouping?

A. Alkaptonuria : Homogentisate oxidase : Phe and Tyr
B. Maple syrup urine disease: -ketodehydrogenase: Leu, Ile, Val
C. Phenylketonuria : phenylalanine hydroxylase: Phe
D. Pernicious anemia: methylmalonyl CoA (Vit B_{12}): Ile, Met, Val
E. Homocysternuria: cystathionine -synthase: cysteine

Dr. Repka

16. What must first happen to LDL before it can bind to the scavenger receptor on macrophages?

A. LDL is modified by oxidation.
B. LDL must exchange apolipoprotein B_{100} for apolipoprotein B_{48}.
C. LDL must exchange apolipoprotein B_{100} for apolipoprotein C.
D. A saturated fatty acid is bound to its apolipoprotein B_{100}.
E. Its cholesterol ester transfer protein must be deactivated.

17. Patients with pancreatic disease who are unable to produce pancreatic lipase can digest triacylglycerol if its constituent acyl groups (fatty acids) are

A. saturated.
B. polyunsaturated.
C. monounsaturated.
D. shorter than 11 carbons in length.
E. longer than 18 carbons in length.

18. Fatty liver syndrome is characterized by the excessive accumulation of triacylglycerol in the liver. What is its most common cause?

A. Excessive intake of dietary fat
B. Alcohol abuse
C. Impaired synthesis of apolipoprotein B_{100} by hepatocytes
D. Inherited defect in the hepatic lipase gene
E. Inherited defect in the hormone-sensitive lipase gene

19. What is the primary source of blood cholesterol over a 24 hour period?

A. Dietary intake
B. Adipose tissue cholesterol stores
C. Muscle tissue stores
D. Synthesis in the liver
E. Chylomicrons

20. Dietary fat is preferentially stored following a meal while dietary carbohydrate is catabolized to meet the energy needs of the body. How is this selection accomplished?

A. Insulin, released in response to increased blood glucose, activates lipoprotein lipase in adipose tissue.
B. Receptors on adipose cell membranes are stimulated by blood glucose to take up chylomicrons which accumulate in adipose cells.
C. Dietary triacylglycerol is retained in the liver following a meal and is later incorporated into VLDL for transport to adipose tissue for storage.
D. Epinepherine, released when the concentration of blood glucose increases, inhibits hormone-sensitive lipase.
E. Chylomicrons can not be catabolized by muscle tissue.

21 The concentration of non-esterified fatty acids in the blood is highest

A. following digestion and absorption of a meal.
B. when the concentration of chylomicrons in the blood is high.
C. when the concentration of LDL in the blood is high.
D. when the concentration of albumin in the blood is high.
E. in the fasted state.

22. Which of these protein foods has the lowest percentage of fat as saturated fat?

A. Beef steak
B. Cheese
C. Fish
D. Chicken breast
E. Ham

23. Which of the drugs used to treat dyslipidemia would be the best choice for a person who has normal blood triglycerides but a mildly elevated LDL cholesterol (20 % above the recommended range) and a very low HDL cholesterol?

A. An HMG-CoA reductase inhibitor (statin)
B. A bile acid sequestrant
C. Niacin
D. Gemfibrozil
E. Aa statin plus a bile acid sequestrant

Dr. Sanchez

For questions 24 through 30 choose from the following.

A. Cyclic AMP
B. Ca^{++}
C. Phosphatidyl inositol-4,5-bisphosphate (PIP_2)
D. Inositol trisphosphate (IP_3)
E. Cyclic GMP
F. Diacylglycerol (DAG)

24. Activates calmodulin B

25. Produced by adenylate cyclase linked to stimulatory G protein (G_s) A

26. Produced by phospholipase C linked to G_q (G_p) F

27. Causes release of Ca^{++} from intracellular stores D

28. Binds and activates protein kinase A (PKA) A

29. Synthesis is increased in response to nitric oxide E

30. Synthesis is decreased in response to light E

31. Binds and activates protein kinase C (PKC) F

Dr. Crissman

For questions 32 through 35, match the cell listed below to its proper function.

A. Is capable of ingesting large particles of material.
B. Is capable of causing the smooth muscles in the bronchioles of the lung to constrict.
C. Is found in the extracellular connective tissue matrix and is derived from B-lymphocytes.
D. secretes the fibers and ground substance of the extracellular matrix surrounding it.
E. None of the above functions match that of this cell.

32. C Plasma cell

33. B Mast cell

34. D Mesenchymal cell

35. A Macrophage

For the following questions, select the one BEST ANSWER or COMPLETION.

36. The process of the a leukocyte leaving the blood vessel and entering into the extracellular matrix is called

A. diapedesis.
B. trapping.
C. adhesion.
D. retraction.
E. none of the above.

37. Select the **INCORRECT** fact about integrin.

A. It is a transmembrane protein which attaches to the cytoskeleton within the cell.
B. It is a cell surface adhesion molecule.
C. Glanzmann's disease results from the inability of integrin to bind to fibrinogen during blood clotting.
D. Improperly formed integrins may prevent leukocytes from migrating out of the blood vessel .
E. All of the above are correct.

Dr. Jacobus

38. Which of the following materials is **NOT** a component of a normal plasma membrane?

A. Phospholipids
B. Cholesterol
C. Carbohydrates
D. Proteins
E. Nucleic Acids

39. The process where a molecule enters a cell faster than predicted by the Law of Diffusion is called

A. simple diffusion.
B. facilitated diffusion.
C. uniport.
D. symport.
E. antiport.

40. Proteins synthesized on soluble polysomes include

A. mitochondrial proteins.
B. peroxisomal proteins.
C. nuclear proteins.
D. soluble proteins.
E. All of the above.

41. Receptor Mediated Endocytosis involves

A. Clathrin-coated pits.
B. Clathrin-coated vessicles.
C. The CURL.
D. Specific ligand receptors.
E. All of the above.

42. Which of the following is **NOT** a component of the normal cytoskeleton?

A. Actin
B. Myosin
C. Intermediate Filaments
D. Microtubules
E. None of the above

43. The phase of mitosis where the chromatids are aligned in a plate is called

A. interphase.
B. prophase.
C. metaphase.
D. anaphase.
E. telophase.

44. The cell-cell junction involved in chemical communication is the

A. gap junction.
B. occluding junction.
C. tight junction.
D. Zonula Adherens.
E. desmosome.

45. The endothelial lining of small blood vessels is most commonly _____ epithelium.

A. simple columnar.
B. simple cuboidal.
C. simple squamous.
D. stratified squamous.
E. None of the above.

Dr. Modyanov

46. Extracellular cross-linking of tropocollagen molecules is initiated by:

A. lysyl oxidase.
B. proline hydroxylase.
C. lysyl hydroxylase
D. the N-terminal propeptide.
E. the C-terminal propeptide.

47. A structural motif that joins two polypeptide chains is

A. EF hand.
B. 8-fold alpha/beta-barrel.
C. 4-helix bundle.
D. Leucine zipper.
E. alpha/beta with saddle in core.

48. The Ramachandran diagram shows the sterically allowed values for the

A. Psi and phi angles of the bonds formed by the alpha carbon in a polypeptide.
B. angle between the C=O and the N-H of the peptide bond.
C. angles of the side chains of the alpha-helix and of beta-pleated sheet.
D. angle of the right-turn twist of the beta-pleated sheet.

49. Hydrophobic interactions might be expected between the "R" groups of which of the following?

A. K and E
B. E and D
C. E and F
D. I and L
E. R and K

50. Which of the following sequences in a polypeptide chain can form a covalent bond with the N-acetylglucosamine of a sugar chain during post-translational modification?

A. Gln-X-Thr
B. Gln-X-Ser
C. Thr-X-Asn
D. Asn-X-Ser
E. Asn-X-Gln

51. Alpha helices

A. have hydrogen bonds between C=O of residue n and N-H of residue n+1
B. have about 7 residues per turn.
C. are almost always found in association with beta strands.
D. normally contain about 20% proline.
E. are right-handed in proteins.

52. Hydrophilic unit of cholesterol molecule is formed by

A. alkyl side chain.
B. OH group.
C. phosphatidic acid.
D. ethanolamine
E. inositol.

53. All of the following are a part of our current concept of biological membranes **EXCEPT**

A. a fluid lipid bilayer.
B. proteins can move laterally in the plane of the membrane.
C. non-covalent association of proteins with the lipid bilayer.
D. proteins are symmetrically distributed on both sides of the membrane.
E. insertion of structural proteins into and across the lipid bilayer.

54. Which of the following statements concerning membrane transport is **FALSE**?

A. Transport ions through channels is always down an electrochemical gradient transport.
B. The cell membrane is a selective permeability barrier.
C. Ion pumps transfer ions across the biological membrane faster than channel proteins.
D. Protein-mediated transport of glucose across the membrane is faster than its simple diffusion through lipid bilayer.
E. The sodium-calcium exchanger is a secondary active transport system that is driven by Na^+ gradient generated by Na,K-pump.

55. Spectrin

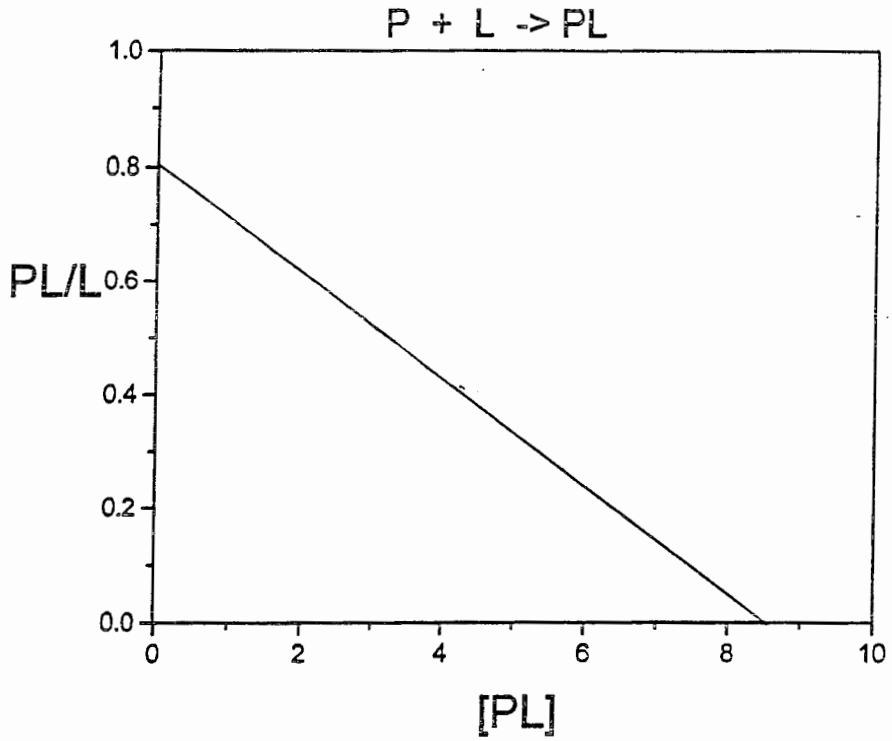
A. is an integral membrane protein.
B. has relatively large domains exposed on outer surface of erythrocytes.
C. contains oligosaccharide chains linked to ASN residues.
D. is a component of a membrane cytoskeleton maintaining integrity of erythrocytes.
E. All of the above are correct.

Dr. Dignam

56. Enzymes can promote catalysis by

A. hydrophobic interactions between residues in the ligand binding site and a substrate.
B. by providing proper orientation of enzyme and substrate reactive groups.
C. by forming a covalent bond with the substrate.
D. by donating to or accepting a proton from the substrate.
E. All of the above are correct.

57. The slope of the Plot shown below defines



A. the number of ligand binding sites on the acceptor.
B. the dissociation constant squared.
C. the negative inverse of the dissociation constant.
D. Fractional saturation.
E. the Hill coefficient.

58. Which of the following statements concerning the role of histidine 146 in the Bohr effect is(are) correct?

A. Protenation results in increased affinity for oxygen.
B. Protenation results in decreased affinity for oxygen
C. The pKa of this histidine is altered, by it proximity to an acidic residue, from the value one would usually expect for a histidyl side chain.
D. Protenation results in decreased carbamylation of the alpha subunit.
E. Answers B and C are correct

59. The binding of 2,3 bisphosphoglycerate to hemoglobin

A. occurs at the same site as oxygen.
B. occurs at two sites per hemoglobin molecule on the alpha subunits.
C. results in increased affinity for oxygen compared to hemoglobin lacking this effector.
D occurs between the two beta subunits through positively charged side chains.
E. results in decreased protenation of histidine 146.

60. In the sequential model for cooperativity proposed by Koshland et. al., Ligand binding

A. always results in increased affinity for ligand binding to neighboring subunits.
B. always results in decreased affinity for ligand binding to neighboring subunits.
C. can result either in increased or decreased affinity for ligand binding to neighboring subunits.
D. stabilizes the taut (low affinity) state.
E. does not alter the affinity of neighboring subunits for ligand.

61. Lyases catalye

A. group transfer.
B. hydrolysis of peptide bonds.
C. joining of two reactants in a reaction requiring energy derived from ATP.
D. √ nonoxidative, nonhydrolytic cleavage of C-C or C-N bonds.
E. oxidation/reduction reactions.

Dr. Mellgren

62. A lipid soluble, uncharged drug undergoes glucuronidation. The drug glucuronide will be

A. less lipid soluble.
B. a candidate for renal tubule secretion.
C. a candidate for enterohepatic cycling.
D. a candidate for biliary secretion.
* E. all of the above statements are true.

63 Which of the following is **NOT** an inducer of cytochrome P_{450}?

A. Ethanol
B. Phenobarbital
C. Polycyclic aromatic hydrocarbons (PAH)
D.. Cimetidine
E. None of the above are inducers.

64. Hemolytic anemia in Middle Eastern or African men treated with the antimalarial, primaquine for

A. glucose-6-phosphate dehydrogenase deficiency.
B. slow acetylator phenotype.
C. codeine oxidation.
D. atypical plasma cholinesterase.
E. none of the above.

Dr. Maltese

65. During beta oxidation of fatty acids, the following compounds are generated **EXCEPT**

A. beta-ketoacyl-CoA.
B. acetyl-CoA.
C. fatty acyl-CoA.
D. NADPH.
E. $FADH_2$.

66. The reducing power ($NADPH + H^+$) for fatty acid synthesis in the cytosol is provided by

A. oxidation of dihydroxyacetone phosphate.
B. extramitochondrial oxidation of malate catalyzed by malic enzyme.
C. catabolism of glucose 6-phosphate via the pentose phosphate pathway.
D. both A and B.
E. both B and C.

67. In liver the immediate precursor of acetoacetate is

A. beta-hydroxy butyrate.
B. acetoacetyl-CoA.
C. beta-hydroxy butyryl-CoA.
D. mevalonic Acid.
E. beta-hydroxy-3-methylglutaryl-CoA.

68. Which of the following is **NOT** a major membrane constituent of mammalian cell membranes?

A. Cholesterol
B. Phosphatidylcholine
C. Protein
D. Triglyceride
E. Sphingolipid

69. Average values for body fat content are

A. 5%.
B. 10%.
C. 15%.
D. 25%.
E. 50%.

70. HMG-CoA reductase

A. catalyzes the reduction reaction for formation of beta-hydroxybutyrate.
B. is stimulated by lovastatin.
C. is not one of the enzymes in the pathway for synthesis of farnesyl-CoA.
D. catalyzes the conversion of lanosterol to cholesterol.
E. is rate limiting for cholesterol synthesis.

71. Fatty acid synthesis and degradation utilize the same

A. acyl carrier.
B. redox cofactor.
C. subcellular location.
D. hydroxacyl intermediate.
E. alpha-beta unsaturated intermediate.

72. The enzyme that utilizes coenzyme A as one of its substrates in the beta oxidation cycle of fatty acids is

A. acyl dehydrogenase.
B. enoyl-CoA hydratase.
C. L-hydroxyacyl-CoA dehydrogenase.
D. thiolase.

73. An example of a nonpolar lipid is

A. lecithin.
B. phosphatidyl serine.
C. phosphatidic acid.
D. palmitic acid.
E. tripalmityl glycerol.

74. Arachidonic acid

A. is a precursor to prostaglandins.
B. has 3 double bonds.
C. has 26 carbons.
D. is released by the action of phospholipase D.
E. is a precursor to cholesterol.

Dr. Wilkerson

For questions 75 through 77 use the answer key below.

A. **Directly proportional to DOSE, but inversely proportional to CLEARANCE.**
B. **A measure of the fraction of a drug dose which reaches the systemic circulation.**
C. **Only influenced by the intrinsic ability of the eliminating organ to handle the drug.**
D. **That volume in which a drug must be distributed, if it were homogeneously distributed throughout that volume in the same concentration as it exists in plasma.**
E. **None of the Above.**

75. Bioavailability of a drug.

76. Drug plasma concentration.

77. Elimination half-life of a drug.

Dr. Koechel **(please see your handout)**

SEE NEXT PAGE FOR ANSWERS

ANSWER KEY

INSTRUCTOR	QUESTION	ANSWER
Dr. Manning	1	B
	2	A
	3	D
	4	C
	5	C
	6	B
	7	D
	8	D
Dr. Rosenberg	9	C
	10	C
	11	B
Dr. Banerji	12	E
	13	A
	14	C
	15	E
Dr. Repka	16	A
	17	D
	18	B
	19	D
	20	A
	21	E
	22	C
	23	C
Dr. Sanchez	24	B
	25	A
	26	D or F
	27	D
	28	A
	29	E
	30	E
	31	F
Dr. Crissman	32	C
	33	B
	34	D
	35	A
	36	E
	37	E

Dr. Jacobus	38	E
	39	B
	40	E
	41	E
	42	B
	43	C
	44	A
	45	C
Dr. Modynaov	46	A
	47	D
	48	A
	49	D
	50	D
	51	E
	52	B
	53	D
	54	C
	55	D
Dr. Dignam	56	E
	57	C
	58	E
	59	D
	60	C
	61	D
Dr. Mellgren	62	E
	63	D
	64	A
Dr. Maltese (Reimann)	65	D
	66	E
	67	E
	68	D
	69	C
	70	E
	71	E
	72	D
	73	E
	74	A
Dr. Wilkerson	75	B
	76	A
	77	E